Operating Experience Weekly Summary 97-49

November 28 through December 4, 1997

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EVENTS

1. OPERATOR SPRAYED WITH SULFURIC ACID

On November 20, 1997, at the Idaho National Engineering and Environmental Laboratory Advanced Test Reactor, an operator was sprayed with approximately 50 milliliters of sulfuric acid foam while disconnecting an air hose to an air sparge line of an empty, 8,000-gallon, bulk-acid storage tank. The operator immediately proceeded to a nearby safety shower where building personnel helped him rinse his skin and use the eyewash station. Operations safety oversight staff notified the shift supervisor and requested medical assistance. Medical staff at the central facilities area dispensary determined that the operator had some blistering and skin discoloration on his left ear and neck and on the inside of both arms. Pre-job planners did not recognize that the sparge line air hose connection should have been included inside the boundaries of the work zone. If the boundaries had been properly selected, the operator would have been required to wear personal protective equipment. (ORPS Report ID--LITC-ATR-1997-0025)

Investigators determined that the operator was working outside of the posted area and was not required to wear protective clothing. He attached the hose between the instrument air line and the acid tank sparge line in support of a job to remove approximately 30 gallons of sludge from the bottom of the tank. Investigators also determined that facility managers had prepared a job safety analysis plan, safe work permit, confined space permit, and job plan instructions and had performed an industrial hygiene safety review. The safety plan did not specifically address attachment of the air hose and the valve sequence for connecting and disconnecting compressed air to the air sparge line. However, an engineer and senior operations oversight person were in attendance throughout the job in an attempt to ensure that all safety aspects of the job were considered and adhered to. Investigators determined that job plan developers required an air flow into the storage tank through the sparge line as an extra source of fresh air for the worker inside the tank. The air sparge line was designed to introduce air inside the filled tank at the bottom so that a stirring action would result as air bubbles rose through the acid.

After the work inside the tank was complete, the operations safety oversight person directed the operator to secure air flow to the air sparge line and detatch the air hose at the hose fitting (see figure 1-1). Investigators determined that the operator closed the isolation valve on the tank side of the hose fitting, then closed the isolation valve nearest the instrument air source. After turning down the air pressure regulator and allowing air pressure to bleed off, the operator disconnected the hose at the hose fitting on the sparge line. When he broke the connection, he was sprayed with a foamy substance primarily containing sulfuric acid. Investigators surmised that over a period of time, acid accumulated in the air sparge line. The acid entered the air hose sometime after workers connected it to the fitting and opened the isolation valves. They also determined that the air hose was not fully de-pressurized when the operator disconnected it at the sparge line hose fitting and that the residual pressure was sufficient to force the foam-like acid out of the fitting.

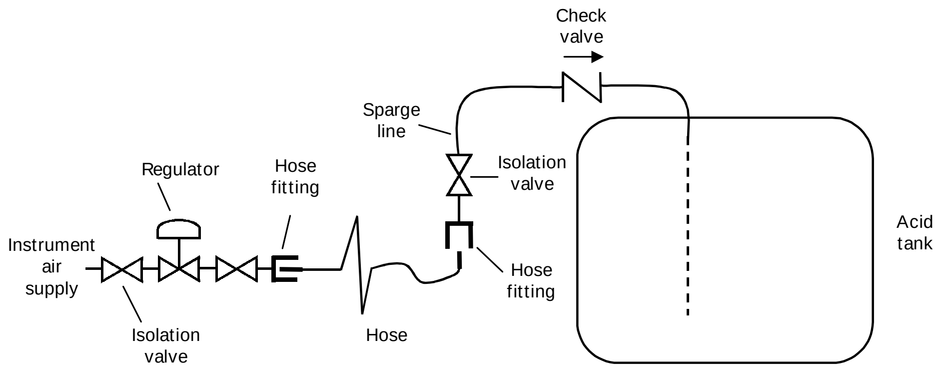


Figure 1-1. Simplified Schematic of Air Sparger Connection

This event illustrates the importance of identifying the boundaries of work zones. Despite extensive safety pre-planning and oversight, facility personnel did not recognize the conditions leading to the acid spray. This event could have had much more serious consequences. Facility managers responsible for planning work on systems containing hazardous chemicals or with flow paths connected to hazardous chemicals should be conservative when establishing work zone boundaries. Article 3 on page 5 describes another event involving an operator sprayed with low-level radiated sludge at the Savannah River Site.

OEAF engineers searched the ORPS database for events with a nature of occurrence of occupational illness and injuries and found 572 events. Figure 1-2 shows the root causes for these events. A review of these occurrences shows that managers reported 37 percent of the root causes as personnel error, of which 43 percent are attributed to inattention to detail. In addition, they reported 35 percent of the root causes as management problems with 28 percent attributed to inadequate administrative control and 21 percent attributed to work planning deficiency.

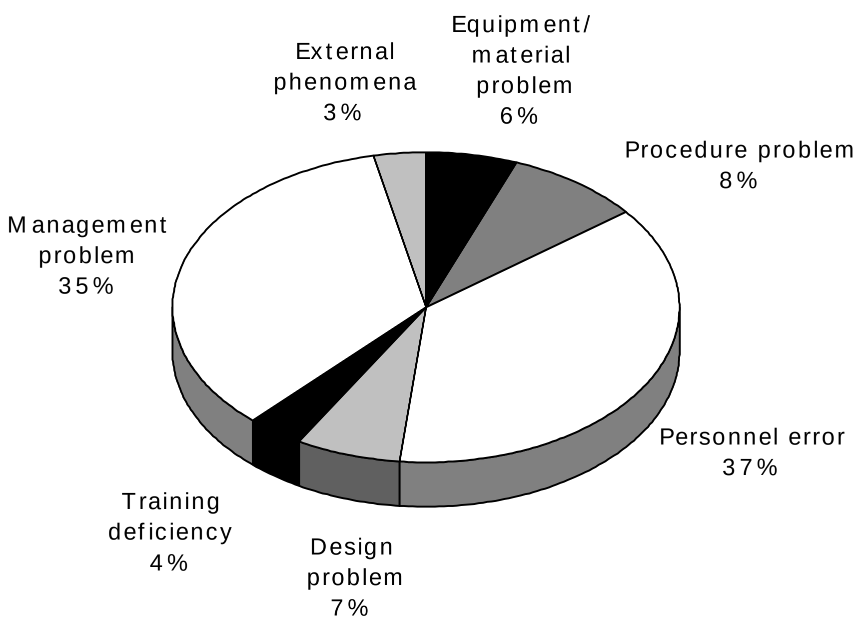


Figure 1-2. Root Causes for Occupational Illness and Injuries[1]

Facility managers responsible for determining the boundaries of work zones must have a thorough understanding of the system being worked on and an understanding of hazard and barrier analysis. The *Hazard and Barrier Analysis Guide*, developed by OEAF, discusses barriers that provide controls over hazards associated with a job. Barriers may be physical barriers, procedural or administrative barriers, or human action. The reliability of barriers is important in preventing undesirable events such as acid burns. The reliability of a barrier is determined by its ability to resist failure. Barriers can be imposed in series to provide defense-in-depth and to increase the margin of safety. The *Hazard and Barrier Analysis Guide* provides a detailed analysis for selecting optimum barriers, including a matrix that displays the effectiveness of different barriers in protecting against some common hazards.

A copy of the *Hazard and Barrier Analysis Guide* is available from Jim Snell, (301) 903-4094, and may also be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Road, Germantown, MD 20874.

KEYWORDS: acid, hazard analysis, injury, work planning

FUNCTIONAL AREAS: Hazards and Barrier Analysis, Work Planning

2. SPRINKLER HEADS FAIL UNDERWRITERS LABORATORY TEST

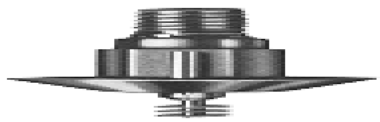
On November 26, 1997, at the Hanford Site Plutonium Finishing Plant, a fire system cognizant engineer notified the building emergency director that three of seven Omega flow control sprinklers removed from the facility for testing by the manufacturer failed during testing. The manufacturer, Central Sprinkler Corporation, notified customers of a potential defect with their Omega series sprinklers and asked them to submit samples for testing. Underwriters Laboratory recommends that these sprinklers flow water at a minimum pressure of 7 psig. The three sprinklers that failed did not flow water until the test pressure reached 12, 20, and 50 psig. The water pressure in the Plutonium Finishing Plant fire suppression system is greater than 100 psig. The fire system cognizant engineer determined that fire suppression systems remained operable because the system water pressure was so much greater than the operating pressures for the failed sprinklers. The vendor will replace all of the approximately 780 Omega sprinklers at the Plutonium Finishing Plant. Failures of this type may allow fires to result in excessive damage to facilities or endanger the lives of building occupants. (ORPS Report RL--PHMC-PFP-1997-0050)

Central Sprinkler Corporation determined that non-activation of the Omega sprinklers at low pressures is caused by reactions between an internal o-ring and residual hydrocarbons in the sprinkler system water from cutting oils or from improper use of stop-leak products. In June of 1996, Central Sprinkler changed the o-ring material from ethylene propylene diene monomer to silicone, eliminating the hydrocarbon reaction problem.

On August 13, 1997, Underwriters Laboratories issued a press release strongly urging property owners whose buildings are equipped with Omega sprinklers to immediately submit samples of the sprinklers to Underwriters Laboratory or Central Sprinkler Corporation for operational testing. Although other manufacturers make similar-looking models, Omega sprinkler models are generally identified by their three circular heat collection fins.

[1] OEAF engineers searched the ORPS database using the graphical user interface for reports with a nature of occurrence code of "3A" (occupational illness and injuries) and found 572 events. Based on a random sampling of 200 events, OEAF engineers determined that each slice is accurate to within 0.4 percent.

Figure 2-1 shows general representative samples of the Omega sprinkler. The Omega series includes models C-1, C-1A, C-1A PRO, C-1A PRO ID, EC-20, EC-20 A, EC-20 AID, HEC-12, HEC-12 ID, HEC-12 PRO, HEC-12A PRO, HEC-12 RES, HEC-20, HEC-20 ID, R-1, R-1A, R-1M, AC, M, and the flow control model used at the Plutonium Finishing Plant.



Pendant (C-1)

Flow Control

Figure 2-1. Omega Sprinkler Heads

Underwriters Laboratory is an independent, not-for-profit product safety certification organization that has been investigating and listing automatic sprinklers for fire protection for more than 90 years. Copies of press releases pertaining to the Underwriters Laboratory investigation of Omega sprinklers can be obtained at URL http://www.ul.com. Underwriters Laboratory also established a toll-free number, (800) 758-1794, to help property owners and managers arrange for samples of Omega sprinklers to be sent to them for testing. Sprinkler samples may also be submitted to the manufacturer for testing. Samples should be sent to the attention of Andy Post, Consumer Service Coordinator, Central Sprinkler Corporation, 451 North Cannon Avenue, Lansdale, PA 19446. Mr. Post can also be contacted by phone at (215) 362-0700 or (800) 523-6512.

In general, DOE facility managers should ensure that surveillances of operational safety-related systems are completed and that these systems are properly maintained. If the system cannot pass surveillances or be maintained operational, appropriate compensatory measures should be taken. DOE O 5480.22, *Technical Safety Requirements*, general principle 1, states: “A system is considered operable as long as there exists assurance that it is capable of performing its specified safety function(s).”

Facility managers responsible for fire safety should ensure that systems are installed, inspected, and maintained using National Fire Protection Association (NFPA) standards. NFPA 13, *Installation of Sprinkler Systems*, is the fundamental document that governs the design and installation criteria for installing sprinkler systems. NFPA 25, *Inspection, Testing, and Maintenance of Water-based Fire Protection Systems*, is another reference that facility managers should consult when performing acceptance testing and periodic testing and maintenance. Ordering information for NFPA documents may be found at the NFPA Home Page located at URL http://www.nfpa.org. DOE implementation of NFPA 25 can be found at the DOE Fire Protection Home Page at URL http://nattie.eh.doe.gov:80/fire/directives.html.

DOE O 420.1, *Facility Safety*, section 4.2.2, "Fire Protection Design Requirements," specifies requirements for automatic fire extinguishing systems and establishes the requirement that DOE elements and contractors develop, implement, and maintain a comprehensive fire protection program.

KEYWORDS: fire suppression, inspection

FUNCTIONAL AREAS: Fire Protection

3. OPERATOR SPRAYED WITH CONTAMINATED SLUDGE

On December 1, 1997, at the Savannah River Site, an operator was sprayed with low-level radiated sludge while repositioning valves after he removed a lockout/tagout on a pressure indicator (gage). When the operator opened a sludge pump discharge valve, sludge sprayed from a flange at the pressure indicator, contaminating his clothing from the left waistline down to his shoes. He immediately closed the valve to stop the sludge and notified his supervisor over the public address system. Three radiation technicians responded to the scene. They surveyed the operator's clothing and detected 10,000 dpm/100 cm^2 beta/gamma and 80 dpm/100 cm^2 alpha. They removed his clothing and shoes, performed a whole-body surveyed, and detected no contamination. Nasal and saliva smears were also negative. Investigators determined that the flanges were not properly aligned, allowing the sludge to leak past a gasket. Mechanics did not perform a leak check of the system after installing the pressure indicator. (ORPS Report SR--WSRC-RMAT-1997-0011)

Mechanics had removed the pressure indicator from the piping system to calibrate it. When they replaced it, the flanges did not fit up tightly, allowing the sludge to leak past the gasket. The pressure indicator is located in a vertical run of 3-inch diameter piping between the discharge of the sludge pump and the discharge isolation valve. The operator did not realize that the flanges were not tight. When he opened the discharge isolation valve, which was used as an isolation boundary, the sludge in the piping system flowed back down the line to the pressure indicator.

Investigators determined that operators had isolated, depressurized, flushed, and drained the piping before the mechanics worked on the pressure indicator. They believe that a recent modification to the piping system to provide backup pumping capability could have contributed to the difficulty in mating the flanges on the pressure indicator to the piping flanges. Mechanics had welded new piping to install a redundant sludge pump, and investigators believe that the process of cutting and welding may have affected the piping length. Mechanics corrected the flange problem by using a full-faced gasket with thicker material rather than the original ring gasket. The facility manager issued a standing order that requires piping systems to be leak-tested.

NFS has reported numerous events in the Weekly Summary where workers were sprayed with potentially hazardous materials (see Article 1 on page 1 regarding an operator at the Idaho National Engineering and Environmental Laboratory who was sprayed with sulfuric acid foam.) Following are some additional examples.

- Weekly Summary 96-45 reported that potentially contaminated sludge sprayed five workers at the Savannah River Site when a mechanic disconnected a pressurized discharge hose from a positive displacement pump. The mechanic was troubleshooting the pump to determine why it was not operating. When he opened a quick-disconnect fitting, the hose blew 3 inches in the air and sprayed sludge 10 feet, hitting three people working inside a contamination area and two others outside the area. Radiological control inspectors surveyed all affected personnel and detected no contamination. (ORPS Report SR--WSRC-REACL-1996-0005)

- Weekly Summary 95-48 reported that a subcontractor at the Weldon Spring Site was sprayed with raffinate sludge contaminated with Th-230 while removing a pressure gage. Raffinate is a waste product of a uranium recovery process. Health physics technicians estimated his maximum skin contamination was 35,853 dpm/100 cm^2 alpha. Investigators found blockage in the line that prevented pressure relief when the system was bled. (ORPS Report ORO--MK-WSSRAP-1995-0022)

- Weekly Summary 92-11 reported that five people at the Savannah River Site were sprayed with non-hazardous sludge when maintenance personnel removed a pH probe from a pressurized system. Investigators determined that a drain line was blocked with solidified sludge, which gave the appearance that the line was depressurized when personnel opened the drain valve. (ORPS Report SR--WSRC-TNX-1992-0003)

These events illustrate the importance of exercising caution when working with potentially pressurized systems. When a piping system is opened for maintenance, personnel should verify the integrity of the piping system by performing a leak check. This can be performed separately or as part of post-maintenance testing. Leak checks should be performed using air or water that is not contaminated to minimize the spread of contamination or hazardous material if a leak is present. According to the hazard-barrier matrix in the *Hazard and Barrier Analysis Guide*, developed by OEAF, physical barriers, such as the integrity of the piping systems and valves, are the most effective against pressure and chemical sources and radioactive material. Facility managers should also review the following guidance.

- DOE-STD-1050-93, *Guide To Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities*, defines a post-maintenance test as any appropriate testing performed following maintenance to verify that (1) a particular piece of equipment or system performs its intended function based on its design criteria, (2) the original deficiency has been corrected, and (3) no new deficiencies are created.

- DOE-STD-1039-93, *Guide To Good Practices for Control of Equipment and System Status*, section 4.8, states that post-maintenance testing should verify that maintenance was performed correctly and that no problems were introduced as a result of the maintenance.

- DOE/EH-0513, Safety Notice 95-04, “Post-Maintenance Test Programs,” issued by NFS in December 1995 provides guidance and good practices for establishing effective post-maintenance test programs.

Safety Notice 95-04 can be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Road, Germantown, MD 20874. Safety Notices are also available on the OEAF Home Page at http://tis.eh.doe.gov:80/web/oeaf/lessons_learned/ons/ons.html. A copy the *Hazard and Barrier Analysis Guide* is available from Jim Snell, (301) 903-4094, and may also be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Road, Germantown, MD 20874.

KEYWORDS: contamination, leakage, pipe joint, post-maintenance testing

FUNCTIONAL AREAS: Mechanical Maintenance, Operations, Radiation Protection

4. PLASTICIZED LINER FOUND IN EMERGENCY DIESEL GENERATOR STRAINER

On November 26, 1997, operators at a commercial nuclear power plant discovered a 70-square-inch piece of plasticized polyvinyl chloride (PVC) liner lodged in an emergency diesel generator strainer. The liner coated the inside of service water system piping that provides cooling for the diesel generator. The failed piece was approximately 7 inches wide and tapered to a point, making it roughly triangular in shape. Investigators determined that the contour of the piece indicated that it probably came from a pipe 8 or 10 inches in diameter. They believe that the wide end of the piece is a portion of a flange joint section. Based on the portions of the service water piping that contain this coating, plant engineers determined that the reactor building component cooling water heat exchangers could also be affected by this problem. Introduction of foreign materials into cooling water systems could cause blockage and result in reduced or lost cooling of systems important to plant safety. (NRC Event No. 33316)

Investigators determined that originally the carbon-steel piping systems were epoxy-lined. After numerous through-wall leaks caused by failures of the original epoxy lining, engineers decided to replace the epoxy-lined piping with plasticized PVC-lined carbon steel piping. They implemented this design change in a five-phase approach between 1988 and 1995. Engineers replaced the emergency diesel generator supply piping, which is where investigators believe the failed piece originated, during Phase 4 in 1992. The replacement piping sections were sent to the Arbonite Division of P & R Industries, Inc., for application of the lining. The lining (a PVC plastisol with the trade name of Arbosol®) is black in color, approximately 3/16 inch thick, and generally pliable and "rubber like." After Arbonite returned the lined piping, personnel at the power plant installed "spool" sections of the piping in the cooling water system.

Investigators have not determined the exact location of the PVC lining failure or the cause of the failure. Before this discovery, no one had reported any instances of PVC liner unbonding or tearing, and no pieces of PVC lining were ever found in strainers or heat exchangers. Investigators believe that the failure may be the result of a manufacturing defect because plant experience has shown that it is very difficult to remove the liner from the inside diameter of the pipe.

The only failure mechanism of the PVC lining material previously identified at the plant was in 1992, when investigators found that the PVC material was susceptible to cracking at the corner of the pipe inside diameter and the flange face. They determined this type of failure was caused by the use of red rubber gaskets. Because the gaskets were harder than the PVC lining, the liner material deformed and cracked when the flange joint was bolted up. Once the liner material was cracked, the underlying carbon steel pipe was subjected to corrosion by exposure to sea water. Maintenance personnel successfully corrected this lining failure by removing the PVC material at the flange face and several inches into the pipe and coating the area with Arcor S-30 epoxy.

Engineers plan to inspect the PVC-lined piping in the plant to determine the cause of the failure and to make necessary repairs. For further information please contact plant engineers Tom Moore at 860-447-1791, Ext. 6017, or John Majewski at Ext. 0840.

KEYWORDS: coatings, liner, pipe, polyvinyl chloride, protective, corrosion, erosion

FUNCTIONAL AREAS: Operating Experience, Construction, Design

5. CONTAMINATED LUBRICANT AFFECTS OPERATION OF MOTOR-DRIVEN RELAYS

On October 13, 1997, ABB Combustion Engineering reported a 10 CFR Part 21 notification to the Nuclear Regulatory Commission (NRC) regarding problems with Potter & Brumfield Company model 170-1 and 7032 motor-driven relays. The manufacturer identified the problem as a contamination of the lubricant that causes it to harden and results in relay failure. Potter & Brumfield supplies the relays to ABB Combustion Engineering for use in the plant protection systems at commercial nuclear power plants. (NRC Event No. 33077)

On November 17, 1997, representatives of Potter & Brumfield extended the problem to include all motor-driven relays with date codes 9317 (the 17th week of 1993) through 9532 (the 32nd week of 95). Previously they thought only models with date codes of 94XX were affected. The manufacturer started adding a lubricant to the motor-driven relays in 1988, and they believe the contamination occurred during the manufacturing process. They determined that assemblers could accidentally introduce glass-fiber particles into the lubricant when they assemble the switch decks in the relay. The representatives stated that, over time, relay operation, as well as temperature changes, could cause the contaminated lubricant to harden.

NFS has reported the following events in the Weekly Summary involving motor-driven relay problems.

- Weekly Summary 93-52 reported that engineers at a commercial nuclear plant notified the NRC that several motor-driven relays were defective. The relays were Potter & Brumfield models 7032, 7033, and 7034, with date codes between 9239 and 9349. The engineers determined that the relays had insufficient shaft end-play, which caused the relay to bind and not actuate. The cause of the end-play defect was traced to rework of the coil size, which was gauged to an incorrect specification and resulted in use of a coil that was too large. (NRC Event No. 26529)

- Weekly Summary 93-04 reported that ABB Combustion Engineering submitted a 10 CFR Part 21 notification to the NRC because some Model 170-1 motor-driven relays failed after 50 cycles even though they were qualified to 100,000 cycles. Engineers determined that the relay problems were caused by failure of the rotor return spring. The springs were supplied to Potter & Brumfield by Lewis Spring Company and were installed in 172 relays, models 170-1, 7032, 7033, and 7034. All have date codes between 9228 (the 28th week of 1992) and 9251 (the 51st week of 1992). (NRC Event No. 24877, Part 21 Log # 93-016)

Hardened or contaminated lubricants have also resulted in the failure of circuit breakers. NRC Information Notice 95-22, “Hardened or Contaminated Lubricants Cause Metal-Clad Circuit Breaker Failures,” described several instances involving 4-kilovolt HK series and 600-volt K-line breakers manufactured by Asea Brown Boveri and 480-volt DB-50 breakers manufactured by Westinghouse. The circuit breakers failed because lubricating grease solidified with age in the breaker operating mechanisms, causing increased friction in metal-to-metal contact areas. The friction, as well as interference from hardened grease deposits, caused the mechanism to become increasingly difficult to operate until the breaker failed. Information Notice 93-26, “Grease Solidification Causes Molded Case Circuit Breaker Failure to Close,” also described problems with 400-amp frame, 600-volt ac molded-case circuit breakers (part number TJK436Y400) manufactured by General Electric Company. Hardening of soap-based or clay-based grease caused these breaker failures. (Weekly Summary 96-03; NRC Information Notices 95-22 and 93-26)

ABB Combustion Engineering stated in their notification that Potter & Brumfield will complete their root cause analysis on the failure mechanism and issue a report detailing the date code identification and recommended corrective actions. For additional information, contact Marty Ryan of ABB Combustion Engineering at (860) 285-6863.

KEYWORDS: lubricant, relay, operating experience

FUNCTIONAL AREAS: Operating Experience, Instrument and Control, Procurement

FINAL REPORT

1. CHEMICAL REACTION RUPTURES DRUMS

This week OEAF engineers reviewed a final report about two 55-gallon drums of phosphoric acid that ruptured and spilled acid onto the floor of a storage cell area at Pacific Northwest National Laboratory. On July 29, 1997, a packager working in the facility heard a noise coming from the storage cell, opened the door to investigate, and discovered the acid spill. Waste management personnel determined that the drums overpressurized, ruptured, and spilled approximately 100 gallons of acid into sumps used for spill control. They also determined that workers mixed incompatible materials (phosphoric acid and metal) that caused a chemical reaction in the drum. Failure to select the appropriate drum type for storing phosphoric acid led to a hazardous spill and could have resulted in personnel injuries, exposures to the hazardous drum contents, or facility damage. (Weekly Summary 97-32; ORPS Report RL--PNNL-PNNLBOPER-1997-0022)

Investigators determined that previous packaging procedures required packaging personnel to ensure that the containers conformed to DOT regulations. They also determined that packaging personnel checked material safety data sheets and chemical handbook data to ensure that all materials stored inside the containers were compatible. However, facility managers determined that information in the material safety data sheets was inconsistent and could not be relied on to provide all possible incompatibilities. Facility managers also determined that even though packaging personnel reviewed chemical handbook data, they focused on the chemical inside the drum and did not consider a chemical reaction with the drum because it was a DOT-approved container.

Facility managers determined that a design problem (error in equipment or material selection) was both the direct and root cause of this event. They determined that the drums selected allowed hydrogen gas generation, causing the drums to overpressurize and spill acid. Had facility personnel performed design, hazard, or safety risk reviews and evaluated the drum material and its contents, the chemical incompatibility would have been identified. Facility managers determined that the contributing cause was a procedure problem (defective or inadequate procedure) because packaging procedures did not ensure that inorganic acid operations were reviewed for material incompatibilities. Facility managers directed personnel to implement the following corrective actions.

- Revise facility packaging operation procedures for chemical compatibility determinations to ensure that they address inorganic acids and require personnel to use additional chemical resources when evaluating chemical compatibility.

- Investigate compatibility issues associated with the acid and the DOT-approved drum and issue a request to DOT for changes in DOT packaging guidance.

- Verify facility compliance with state administrative codes and compliance with site Resource Conservation and Recovery Act requirements.

- Issue a site-wide lessons learned memorandum to (1) inform packaging personnel about potential reactions between phosphoric acid and metal drums and (2) remind personnel that material safety data sheets and chemical handbooks may not provide all necessary information to determine compatibility.

NFS reported incompatible chemical mixing and storing events in Weekly Summaries 97-30 and 97-22. NFS also reported numerous pressurized drum events in the past year. Following are some examples.

- Weekly Summary 97-30 reported that a sealed, plastic-lined, 55-gallon drum, containing organic waste materials from the cleanup of a nitric acid spill, overpressurized and blew the lid off the drum at the Oak Ridge Y-12 Site. The force of the venting caused the lid to strike and bend an overhead fire protection system pipe and dislodge the pipe hangers. (ORPS Report ORO--LMES-Y12WASTE-1997-0004)

- Weekly Summary 97-22 reported that a waste shipping container overpressurized, ruptured, and was damaged by heat generated from an unexpected chemical reaction between uranium, water, and magnesium at the Fernald Environmental Management Project. (ORPS Report OH-FN-FDF-FEMP-1997-0034)

These events highlight the need for managers of facilities that generate, receive, and ship chemicals to develop appropriate programs and procedures to identify chemical compatibility. These programs should address safe handling, storage, and transportation requirements for chemicals. Facility managers should ensure that workers are familiar with facility safety precautions and emergency procedures. They should also provide workers with the necessary information to ensure accurate and complete compatibility evaluations. Hazardous chemicals must be identified and their risks understood. Risks should be evaluated, and barriers should be put in place to reduce them. Facility managers should emphasize the importance of researching all available sources of chemical safety information, particularly when performing first-time or infrequent operations.

Information about chemicals, chemical hazards, and chemical safety programs can be found on the DOE Office of Environment, Safety and Health, Office of Worker Safety, Chemical Safety Program Home Page. The home page (located at URL http://tis-hq.eh.doe.gov/web/chem_safety/) provides links to many sources of information, including requirements and guidelines, lessons learned, chemical safety networking, and chemical safety tools.

Facility managers should review the following references to ensure facility procedures address all aspects of chemical compatibility and packaging.

- 49 CFR 173.24, *General Requirement for Packagings and Packages*, section e, states: “It is the responsibility of the person offering a hazardous material for transportation to ensure that such packagings are compatible with their lading. This particularly applies to corrosivity, permeability, softening, premature aging, and embrittlement. Packaging materials and contents must be such that there will be no significant chemical or galvanic reaction between the materials and contents of the package.”

- DOE/EH-0557, Safety Notice 97-01, "Mixing and Storing Incompatible Chemicals," contains lessons learned related to the mixing and storing of incompatible chemicals. It also references a list of chemical incompatibilities provided by the University of Michigan.

- DOE/EH-0296, Bulletin 93-2, "Mixing of Incompatible Chemicals," February 1993, provides information about the hazards associated with mixing of incompatible chemicals.

- The Office of Defense Programs published two Safety Information Letters, SIL 96-05, *Compatibility Considerations in the Mixing of Waste Chemicals,* November 1996, and SIL 96-01, *Incidents from Chemical Reactions due to Lack of or Failure to Follow Proper Handling Procedures,* June 1996, that address chemical hazards and provides guidance to prevent similar incidents.

Safety Notice 97-01 and Bulletin 93-2 can be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Road, Germantown, MD 20874. Safety Notices are also available on the Operating Experience Analysis and Feedback Home Page at http://tis.eh.doe.gov:80/web/oeaf/lessons_learned/ons/ons.html. A copy of the University of Michigan chemical incompatibility list is available on the Internet at URL http://www.orcbs.msu.edu/chemical/chp/appendixc.html.

KEYWORDS: pressurized drum, chemical reaction, chemical spill

FUNCTIONAL AREAS: Chemistry, Industrial Safety, Materials Handling and Storage